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Method for Heating a Roller, and Heatable Roller

This invention relates to a method for heating a roller used in the production and/or finishing of a web of material, particularly a paper web or paperboard web. It also relates to a heatable roller according to the prior-art portion of claim 26.

For the usual heatable rollers used hitherto in the production and/or finishing of paper, heat is transported into the roller by means of a heat medium. As such, the heat required for heating the roller is transferred indirectly. In this case the medium concerned, which as a rule is oil or water, is heated by means of an external heating unit. As a rule provision was made for operation with electricity, firing with gas or operation with steam.

The object of the present invention is to create an improved method and an improved heatable roller of the type initially referred to. In particular the use of renewable fuels should also be possible.

With regard to the method, this object is accomplished in that the heat required for heating the roller is generated at least in part inside the roller by combusting a fuel with air or oxygen at least in some regions inside the roller.

Hence the heat is generated where it is required. Furthermore, renewable energies can now be used to generate the heat required. In this case the roller can be operated in particular in the manner of a catalytic burner.

According to a preferred practical embodiment of the method according to the invention the heat is generated at least in part on inner heat transfer surfaces of the roller which are coated with a catalyst. The heat can be generated at least in part in at least one space inside the roller which is filled with a catalytic carrier or equipped with a catalytic surface.

A fuel gas is preferably used as fuel.

According to an advantageous practical embodiment of the method according to the invention an exothermic reaction is made to take place on the catalyst using a mixture of fuel gas and air in an adjustable or adjusted mixture ratio.

According to another advantageous embodiment the mixture of fuel gas and air is fed to peripheral bores in the roller and an exothermic reaction is made to take place in these peripheral bores. The peripheral bores can extend generally parallel to the roller axis. The heat gas from the peripheral bores is fed preferably via radial ducts to a duct-filled annular region near the roller surface. As such, the annular region in question can be provided in particular in the roller casing.

The mixture of fuel gas and air is expediently fed to the roller via at least one rotary inlet.

However, the exothermic reaction can also take place in a duct-filled annular region near the roller surface. This duct-filled annular region can be fed, for example, with fuel gas via peripheral bores in the roller and radial ducts extending therefrom and, for example, with air via a central roller bore and radial ducts extending therefrom. However, it is also conceivable to supply a mixture of fuel gas and air.

The significant advantage of a catalytic reaction is that the reaction takes place locally on the catalytically coated surface (ducts in the annular region). If supply lines (peripheral bores, radial bores and central roller bores) are not coated, a mixture of fuel gas and air will not react here. Only the ducts in the inside region are coated and it is only here that a reaction of the reaction mixture with heat transfer takes place.

The mixing of air and fuel gas prior to feeding into the roller is not a disadvantage therefore. However, mixing inside the roller requires additional supply lines, ducts etc. and would be more complex. In principle, such supplying of a mixture is also conceivable however.

Hence in this case too, peripheral bores extending in particular parallel to the roller axis can again be provided. However, here the exothermic reaction does not take place in these peripheral bores but in the duct-filled annular region near the roller surface. The peripheral bores can be used, for example, to feed the fuel gas, while air is fed via the central roller bore for example. In principle, however, such an embodiment in which a mixture of fuel gas and air is fed via the peripheral bores is also conceivable.

Again, the fuel gas or the air is expediently fed to the roller via at least one rotary inlet.

According to a preferred practical embodiment of the method according to the invention, the roller is heatable on a zone basis viewed in the direction of the roller axis, with the various zones being heatable independently of each other at least in part. As such, the zones in question can be operated singly or in groups.

In the case of a roller with a casing rotating around a non-rotatable core the exothermic reaction can also take place in particular in the region of the surface of the roller core or in a duct-filled annular region of the rotatable roller casing. Hence an expedient alternative to an exothermic reaction in the region of the surface of the roller core is, as previously explained, the reaction in the duct-filled annular region of the rotatable roller casing.

In this case an embodiment is conceivable such that, for example, the upright roller core is divided into two parts, namely into an air inlet and a waste gas outlet. Between the upright roller core and the rotatable roller casing provision can be made for seals which enclose the annular regions between both bodies. Through bores in the roller core, connections can be made alternately between the air inlet or the waste gas outlet and the annular regions. Radial bores in the roller casing can be used for connection of the catalytically coated ducts with the annular regions.

The roller is preferably divided by means of seals and several feed ducts or bores opening into the duct structures for fuel gas and air or a mixture of fuel gas and air into various axial zones that are heatable independently of each other at least in part. Lines feeding the fuel gas can open into the feed ducts or bores. Furthermore, these feed ducts or bores can communicate with an air-conveying central bore of the roller core.

The reaction or roller temperature is advantageously set by means of the fuel/air mass flow ratio (stoichiometry).

In certain cases an overstoichiometric combustion or combustion with a surplus of oxygen can be expedient.

The fuel used can be particularly hydrogen. In particular the use of reformat or an H_2-rich gas obtained from natural gas is also an advantage.

In particular at least one noble metal such as in particular platinum, palladium, rhodium and/or the like can be used as catalyst.

The fuel gas mass flow is advantageously controlled such that particularly a volumetric flow measurement and a corresponding control valve can be provided as well.

It is also an advantage particularly if the fuel gas concentration in the air is controlled preferably by means of a fuel gas sensor and a corresponding control valve.

It is expedient for the roller temperature as well to be controlled.

Again, a respective control can also take place particularly on a zone basis, whereby the zones can be controlled singly or in groups.

With regard to the heatable roller, the object of the invention mentioned above is accomplished in that the heat required for heating is generated at least in part by combusting a fuel with air or oxygen inside the roller.

Preferred embodiments of the heatable roller are specified in the subclaims.

The duct structures provided on the surface of the roller core for the embodiment in question can be produced by etching or milling at least in part.

The coating with the catalyst can be produced, for example, by rinse coating, dip coating or spray coating.

The roller casing is preferably shrink-fitted and/or soldered to the roller core.

The invention will be described in more detail in the following text using exemplary embodiments and with reference to the drawing, in which:

figure 1 is a schematic representation, partly in section, of a heatable roller fed with fuel gas and operated in the manner of a catalytic burner,

figure 2 is a schematic representation in cross-section of an embodiment of the heatable roller on which the mixture of fuel gas and air is fed to peripheral bores in the roller and the exothermic reaction takes place in these bores,

figure 3 is a plan view of the heatable roller according to figure 3 showing the ducts provided near the surface to which the heat gas is fed from the peripheral bores,

figure 4 is a schematic representation in cross-section of another embodiment of the heatable roller on which the exothermic reaction takes place in a duct-filled annular region near the roller surface,

figure 5 is a schematic perspective representation of the core of another embodiment of the heatable roller on which the

exothermic reaction takes place in the region of the surface of the roller core,

figure 6 is a schematic perspective representation of an embodiment of the heatable roller with a non-rotating core according to figure 5, also showing the casing that rotates around this core, and

figure 7 is a schematic partial representation in section of another embodiment of the heatable roller with a non-rotating core, but in this case the exothermic reaction again takes place in a duct-filled annular region of the rotatable roller casing.

In a schematic representation, partly in section, figure 1 shows a heatable roller 10 which is fed with fuel gas or a mixture of fuel gas and air and operated in the manner of a catalytic burner. The roller 10 can be for use particularly in the production and/or finishing of a web of material, particularly a paper web or paperboard web.

The heat required for heating the roller 10 is generated at least in part by combusting a fuel with air or oxygen inside the roller 10. Hence the roller 10 is configured in the manner of a catalytic burner.

In this case the roller 10 has inner heat transfer surfaces 12 coated with a catalyst, on which the exothermic chemical reaction takes place. Alternatively or in addition to this, the roller can also comprise at least one inner space which is filled with a catalytic carrier or equipped with a catalytic surface.

A fuel gas, for example hydrogen or the like, can be provided as fuel.

In the case under consideration the heatable roller 10 is fed with a mixture of fuel gas and air in a mixture ratio that is adjustable for an exothermic reaction on the catalyst.

As is evident from figure 1, the air is made available by means of an air blower 14 and fed first via a line section 16 to a mixing point 18, to which the fuel gas is fed via another line section 20 in order to be mixed with the air.

The mixture of fuel gas and air is then fed via a line section 22 to a heat transfer device 24, from which the mixture is fed via a line section 26 to the catalyst-coated heat transfer surfaces 12 and in which the freshly fed mixture is preheated via a line section 26 by means of the waste gas or waste air returned from the heat transfer surfaces 12 of the roller 10.

A control valve 28 and a device 30 for volumetric flow measurement are provided in the line section 20 which feeds the fuel gas.

A fuel gas sensor 32 is arranged in the line section 22 provided between the mixing point 18 and the heat transfer device 24.

The waste gas or the waste air is passed out of the heat transfer device via a line section 34.

On the embodiment under consideration the mixture of fuel gas and air is fed to the heat transfer device 24 at a temperature of around 20 °C for example. In the heat transfer device 24 the mixture is preheated to a temperature of around 200 °C for example. The waste gas or waste air returned from the region of the heat transfer surfaces 12 of the roller 10 to the heat transfer device 24 has a temperature of around 250 °C for

example. The waste gas or waste air passed out of the heat transfer device 24 has a temperature of around 50 °C for example.

The fuel gas fed via the line section 20 can be in particular hydrogen or, for example, a reformat or an H_2-rich gas obtained from natural gas.

The reaction or roller temperature can be set by means of the fuel/air mass flow ratio (stoichiometry). In principle, an overstoichiometric combustion or combustion with a surplus of oxygen can also take place.

The catalyst can be, for example, a noble metal such as in particular platinum, palladium, rhodium and/or the like.

Control of the fuel gas mass flow is possible by means of the control valve and the device 30 for volumetric flow measurement.

The fuel gas concentration in the air can be controlled by means of the fuel gas sensor 32 and, for example, the control valve 38.

It is possible in particular for the roller temperature as well to be controlled by means of a corresponding control valve.

In a schematic representation in cross-section, figure 2 shows an embodiment of the heatable roller 10 on which the mixture of fuel gas and air is fed to peripheral bores 36, E of the roller 10 extending generally parallel to the roller axis.

The heat gas from the peripheral bores 36, E is fed via radial ducts 38, E to an annular region 42 filled with ducts 40 near the roller surface. The exothermic reaction takes place in these ducts 40.

In the case under consideration, twelve peripheral bores 36 are provided for example, whereby the mixture of fuel gas and air is fed via six (36, E) of these peripheral bores to the roller. Here "E" stands for the German "Eintritt", which means "inlet".

In addition, twelve radial bores 38 are provided. In this case the mixture of fuel gas and air flows via six (38, E) of these twelve radial bores in the direction of the distributor ducts 43, E.

As such, there are twelve bores in a sectional plane of the roller, while several bore planes are provided in axial direction.

The gas mixture is distributed via the distributor ducts 43, E in axial direction and then flows via the ducts 40 in the annular region 42 to the distributor ducts 43, A. Here "A" stands for the German word "Austritt" which means "outlet".

The channels 40 in the annular region 42 are catalytically coated. The exothermic reaction thus takes place here.

The reaction product flows via the remaining six radial bores 38, A into the peripheral bores 36, A, through which it is discharged from the roller.

Figure 3 shows a plan view of a part of the heatable roller 10 according to figure 3, showing the ducts 40 provided near the roller surface to which the heat gas is fed from the peripheral bores 36, E (cf. figure 2).

The mixture of fuel gas and air can be fed to the roller 10 via at least one rotary inlet.

Figure 4 shows in a schematic representation in cross-section another embodiment of the heatable roller 10 on which the exothermic reaction takes place in a duct-filled annular region 44 near the roller surface.

Again, this duct-filled annular region 44 near the roller surface is fed with a mixture of fuel gas and air via peripheral bores 46 of the roller 10, which extend generally parallel to the roller axis, and radial ducts 48 extending therefrom. The reaction products (waste gases) are discharged from the roller via radial ducts 52 and the central roller bore 50.

Again, the mixture of fuel gas and air can be fed to the roller 10 via at least one rotary inlet in the case under consideration as well.

Figure 5 shows in a schematic perspective representation the non-rotating core 54 of another embodiment of the heatable roller 10 (cf. in particular figure 6) on which the exothermic reaction takes place, for example, in the region of the surface of the roller core 54. Such an embodiment is an advantage particularly if the roller 10 is heatable on a zone basis viewed in the direction of the roller axis, meaning the various zones are heatable independently of each other at least in part.

Figure 6 shows in a schematic perspective representation a heatable roller 10 equipped with such a core 54 according to figure 5, including the casing 54 that rotates around this core 54.

In the case under consideration the surface of the roller core 54, for example, is thus coated with a catalyst at least in part.

As is evident from figure 5, the roller 10 in the case under consideration is divided by means of seals 58 and several feed ducts or bores 60 opening into the duct structures for fuel gas and air or a mixture of fuel gas and air into axial zones that are heatable independently of each other at least in part. Lines 62 for the fuel gas open in the case under consideration into the feed ducts or bores 60. Furthermore, the feed ducts or bores 60 communicate with an air-conveying central bore 64 of the roller core 54, through which the resulting waste gas is also discharged.

Whereas on the embodiment just described the exothermic reaction takes pace in the region of the surface of the roller core, figure 7 shows in a schematic partial representation in section another embodiment of the heatable roller 10 on which the reaction again takes place in an annular region of the rotatable roller casing 56 filled with ducts 40. Again, the roller 10 is heatable on a zone basis.

The non-rotating roller core 54 is divided in the middle. The division into two parts results in an air inlet 66 and a waste gas outlet 68.

Between the upright roller core 54 and the rotatable roller casing 56 provision is made for seals 70 which enclose the annular regions 72 between the two bodies. Through radial bores 74 provided in the roller core 54, connections are made alternately between the air inlet 66 or the waste gas outlet 68 and the annular regions 72. Radial bores 76 in the roller casing 56 connect the catalytically coated ducts 40 with the annular regions 72.

Fuel gas is fed in via supply lines 78.

Hence in the case under consideration the reaction zones lie in the catalytically coated ducts 40.

List of reference numerals

10	Heatable roller
12	Heat transfer surfaces coated with a catalyst
14	Air blower
16	Line section
18	Mixing point
20	Line section
22	Line section
24	Heat transfer device
26	Line section
28	Control valve
30	Device for volumetric flow measurement
32	Fuel gas sensor
34	Line section
36	Peripheral bore
38	Radial duct
40	Ducts
42	Duct-filled annular region
43	Distributor duct
44	Duct-filled annular region
46	Peripheral bore
48	Radial duct
50	Central roller bore
52	Radial duct
54	Roller core
56	Roller casing
58	Seal
60	Feed duct, feed opening
62	Line
64	Central bore

66	Air inlet
68	Waste gas outlet
70	Seal
72	Annular region
74	Radial bore
76	Radial bore
78	Fuel gas supply line